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EXAMINER	
LIU, LI	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/608,281	HARRES, DANIEL N.	
	Examiner	Art Unit	
	LI LIU	2613	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 November 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *5,8-10,12-14,16,17,19,24,26-29,31-33,35,37,39,40 and 42-45* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *24,26-29 and 31* is/are allowed.

6)☒ Claim(s) *5,8-10,12-14,16,17,19,32,33,35,37,39,40 and 42-45* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *25 July 2007* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/02/2009 has been entered.

Response to Arguments

2. Applicant's arguments with respect to claims 16, 32 and 45 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 16 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Arnon et al (US 2002/0114038) in view of Harres (US 6,128,112) and Nakano (US 6,795,675).

1). With regard to claim 16, Arnon et al discloses an optical system, comprising:

a transmitter (e.g., Figure 4, the emitter 52) configured to transmit an optical signal;

a receiver including an avalanche photodiode (Avalanche Photodiode 150 in Figure 3) configured to receive the optical signal and to output an electrical signal; and

a feedback loop for increasing dynamic range of the receiver when an optical signal is high ([0010] and [0240], the APD is followed by one amplification stage, which together with the APD and feedback from the amplification stage to the APD controlling the gain of the APD, provides a detecting system for communication signals of the network having a high dynamic gain. As shown in Figure 3, the amplifier 152, detector 154, control unit 156, and PS 158 comprise a first negative feedback loop 162 operating as a gain controller for APD 150, for a given level of radiation received at the APD) and preventing breakdown of the avalanche photodiode ([0010] and [0239], the system of Arnon shown in Figure 3 is used to increase the dynamic range of the receiver "so that the saturation of the APD, due to too high a level of the carrier or of the noise level, is prevent"), the component

monitoring a noise level of at least a portion of the electrical signal (the monitoring signal is part of the electrical signal split from the output of amplifier 152, Figure 3), and

reducing at least one of an amplification of the transmitter and a gain of the receiver (page 10-11, [0237]-[0239], the gain of the APD is set according to the optical power level, the background noise level, and the aggregate noise).

But, Arnon et al does not expressly disclose: monitoring a noise level including determining a presence or absence of the optical signal at the receiver, computing at least one of a high state means and a low state means of the electrical signal, computing an average noise energy for the high-state A, computing an average noise energy for the low-state –A, and computing a ratio of the average noise energies for the hiqh- and Low state A, -A, and reducing at least one of an optical amplification of the transmitter and a gain of the receiver when the ratio is greater than a predetermined threshold, the threshold indicating that breakdown of the photodiode is imminent.

However, Harres, in the same field of endeavor, discloses an optical receiver with a monitoring component: monitoring a noise level including determining a presence or absence of the optical signal at the receiver (column 3 line 2-33, and Figure 3, “light” and “dark”, or high state and low state, is determined), computing at least one of a high state means and a low state means of the electrical signal (Figure 3, the powers of the signals at high and low states are calculated), computing an average noise energy for the high-state A, computing an average noise energy for the low-state –A (38 and 40 in Figure 3, column 10 line 11-40), and computing a ratio of the average noise energies for the high- and Low state A, -A (42 in Figure 3, column 10 line 11-40).

With regard to the predetermine threshold, since Arnon teaches to calculate the noise level and use the calculation to control the gain of the APD, it is obvious that a reference value or threshold is used in Arnon’s system to make a decision to adjust the gain. For control purpose, a criterion must be used to judge the level of the signal/noise so to control the operation of the device being controlled. Another prior art, Nakano,

discloses a feedback control circuit (Figures 1 and 2), which uses a reference voltage/or predetermined threshold to control the gain of the APD. Nakano teaches "[t]he alarm circuit 7 receives the noise detection signal 105, counts the noise pulses generated within a predetermined period, and outputs an alarm pulse 107 when the number of the counted noise pulses reaches a preset value. When the level of the optical signal input to the APD 2 is lowered or becomes zero, the APD 2 increases the amplification factor of the optical signal based on the control signal from the feedback control circuit 4".

And Harries also teaches "[a]s supported by equation 7, however, as m>>1, the improvement in S/N asymptotically approaches the expression $1/2(m+2)^{1/2}$. Of coursea natural limit exists on the APD gain (M) beyond which <u>breakdown</u> occurs. In addition, as M becomes very large, the multiplied bulk dark current (the second term in the denominator of equation 2) will begin to dominate. Thus, by increasing the gain M beyond the point at which the multiplied bulk dark current begins to dominate the noise statistics, the SNR will again begin to degrade. Further, since the multiplied bulk dark current exists at all times, i.e., since the bulk dark current is not signal dependent, there currently is no known way to remove its effect using non-linear processing methods. Thus, the gain of the photodetector is preferably maintained at <u>levels below which the bulk dark current dominates</u>."(column 9, line 33-49). Equation 7 is expressed as the ratio of the signal power to the noise power. That is, Harries teaches to reduce a gain of the receiver when the ratio of the signal power to the noise power is greater than a predetermined level, the level indicating that breakdown of the photodiode is imminent. That is, Harries teaches to reduce at least one of an optical amplification of the

transmitter and a gain of the receiver when the ratio is greater than a predetermined level, the level indicating that breakdown of the photodiode is imminent.

Harres teaches that ratio of the average noise energies is used for calculating a weight factor, and to reduce a gain of the receiver when the ratio of the signal power to the noise power is greater than a predetermined level indicating that breakdown of the photodiode is imminent. Nakano teaches that the gain of the receiver can be controlled based on a predetermined threshold of a noise level. And Nakano discloses that the circuit for monitoring the optical signal level may be readily integrated and detect the reduction in the optical signal level or break in the optical signal with reliability (column 5, line 59-65); and compared with other procedure, Nakano's circuit is not "complex" (column 1, line 46-48). Harres provide a more reliable method and apparatus for detecting and decoding digital signals; and "[i]t is a further object of the invention to provide a method and apparatus for reliably detecting low level signals by increasing the gain of the detector without unduly increasing the bit error rate".

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the ratio of the average noise energy states and a predetermined threshold as taught by Harres and Nakano to the system of Arnon et al so that the gain is adjusted when a ratio of the average noise energies for the high- and low-states is greater than a predetermined threshold, and then the gain of the APD can be better controlled and the signal quality and reliability can be improved.

2). With regard to claim 19, Arnon et al and Harres and Nakano disclose all of the subject matter as applied to claim 16 above. And the combination of Arnon et al and

Harres and Nakano further discloses wherein the monitoring component is configured to monitor an output voltage of the electrical signal and to adjust at least one of an amplification of the transmitter (Arnon: Figures 2-5 and 12 etc, [0237]-[0239], [0241] and [0268] etc., the feedback signal is sent to the transmitter to adjust the power level of the transmitter) and a gain of the receiver to maintain a desired RMS level of a electrical signal (Harres: column 10, line 11-28).

5. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Arnon et al and Harres and Nakano as applied to claim 16 above, and in further view of Tomooka et al (US 6,266,169).

Arnon et al and Harres and Nakano disclose all of the subject matter as applied to claim 16 above. But, Arnon et al and Harres and Nakano do not expressly disclose wherein the transmitter includes a optical amplifier.

However, Tomooka et al discloses a transmitter including an optical amplifier (e.g., Figure 1, the optical amplifier 14). The optical amplifier is a well known device in the optical communications, Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a optical amplifier in the system of Arnon et al and Harres and Nakano so that the required input optical power can be obtained, and noise can be better controlled and the signal quality can be improved.

6. Claims 32, 33, 35, 37, 39, 42 and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Arnon et al (US 2002/0114038) in view of Harres (US 6,128,112) and Nakano (US 6,795,675) and Pulice (US 5,270,533).

1). With regard to claim 32, Arnon et al disclose a method of controlling an output of an optical system, the method comprising:

receiving an optical signal with a receiver (Avalanche Photodiode 150 in the opto-electric transducer 162 receives optical signal, Figure 3);

using a photodiode (Avalanche Photodiode 150 in Figure 3) of the receiver to convert the optical signal to a corresponding electrical signal (Avalanche Photodiode 150 converts optical signal into an electrical signal, Figure 3); and

using a feedback loop to increase dynamic range of the receiver when an optical signal is high ([0010] and [0240], the APD is followed by one amplification stage, which together with the APD and feedback from the amplification stage to the APD controlling the gain of the APD, provides a detecting system for communication signals of the network having a high dynamic gain. As shown in Figure 3, the amplifier 152, detector 154, control unit 156, and PS 158 comprise a first negative feedback loop 162 operating as a gain controller for APD 150, for a given level of radiation received at the APD) and preventing breakdown of the avalanche photodiode by adjusting gain of the receiver when the optical signal is high ([0010], [0239] and [0244], the system of Arnon shown in Figure 3 is used to increase the dynamic range of the receiver, "the gain of APD 150 is varied so that the dynamic range of transducer 80 is of an order of 50 dB while the APD remains in its operational range, so that the saturation of the APD, due to too high a level of the carrier or of the noise level, is prevent"),

computing noise in the electrical signal (the monitoring signal is part of the electrical signal split from the output of amplifier 152, Figure 3; the gain of the APD is

set according to the optical power level, the background noise level, and the aggregate noise, [0036] and [0237]-[0239], that is, the noise level is evaluated or calculated by the CPU and controller), and adjusting gain of the photodiode as a function of the computed noise (page 10-11, [0237]-[0239], the gain of the APD is set according to the optical power level, the background noise level, and the aggregate noise) without measuring a temperature of the environment (in Arnon's system, no temperature controlling/monitoring devices are used); and

computing a ratio of high- and low states to prevent breakdown of the photodiode and possible interruption of the receiver ([0016], [0110], [0237]-[0239], [0250], [0291] , the optical power level, the background noise level, the aggregate noise, and the signal to noise ratio are calculated, the gain is controlled so to prevent saturation of the APD).

But, Arnon does not expressly state: computing the ratio of high- and low states to prevent breakdown of the photodiode and possible interruption of the receiver including: computing an average energy for a high-state A of the electrical signal; computing an average energy for the low-state -A of the electrical signal; and comparing a ratio of the average energies for the high- and low-states A, -A with a threshold value, the threshold value indicating that breakdown of the photodiode is imminent; and the receiver is in an environment exhibiting significant variation in temperature.

Regarding to compute an average energy, Harres, in the same field of endeavor, discloses a method to control an output of an optical receiver, in which an average energies for the high-state and low state (column 3 line 2-33) of the electrical signal are

computed (34 and 36 of Figure 3). And Harres teaches that the signal-to-noise ratio can be used for calculating weight factor (column 8 line 61-65).

Regarding to the threshold value, since Arnon teaches to calculate the noise level and use the calculation to control the gain of the APD, it is obvious that a reference value or threshold is used in Arnon's system to make a decision to adjust the gain. For control purpose, a criterion must be used to judge the level of the signal/noise so to control the operation of the device being controlled. Another prior art, Nakano, discloses a feedback control circuit (Figures 1 and 2), which uses a reference voltage/threshold to control the gain of the APD. And Nakano also teaches "[t]he alarm circuit 7 receives the noise detection signal 105, counts the noise pulses generated within a predetermined period, and outputs an alarm pulse 107 when the number of the counted noise pulses reaches a preset value. When the level of the optical signal input to the APD 2 is lowered or becomes zero, the APD 2 increases the amplification factor of the optical signal based on the control signal from the feedback control circuit 4".

And Harries also teaches "[a]s supported by equation 7, however, as m>>1, the improvement in S/N asymptotically approaches the expression $1/2(m+2)^{1/2}$. Of coursea natural limit exists on the APD gain (M) beyond which <u>breakdown</u> occurs. In addition, as M becomes very large, the multiplied bulk dark current (the second term in the denominator of equation 2) will begin to dominate. Thus, by increasing the gain M beyond the point at which the multiplied bulk dark current begins to dominate the noise statistics, the SNR will again begin to degrade. Further, since the multiplied bulk dark current exists at all times, i.e., since the bulk dark current is not signal dependent, there

currently is no known way to remove its effect using non-linear processing methods. Thus, the gain of the photodetector is preferably maintained at <u>levels below which the bulk dark current dominates</u>." Equation 7 is expressed as the ratio of the signal power to the noise power. That is, Harries teaches to reduce a gain of the receiver when the ratio of the signal power to the noise power is greater than a predetermined level, the level indicating that breakdown of the photodiode is imminent. That is, Harries teaches to reduce at least one of an optical amplification of the transmitter and a gain of the receiver when the ratio is greater than a predetermined threshold, and to compare a ratio of the signal power to the noise power with a predetermined level, the level indicating that breakdown of the photodiode is imminent.

Harres teaches that ratio of the average noise energies is used for calculating a weight factor, and to reduce a gain of the receiver when the ratio of the signal power to the noise power is greater than a predetermined level indicating that breakdown of the photodiode is imminent. Nakano teaches that the gain of the receiver can be controlled based on a predetermined threshold of a noise level. And Nakano also discloses that the circuit for monitoring the optical signal level may be readily integrated and detect the reduction in the optical signal level or break in the optical signal with reliability (column 5, line 59-65); and compared with other procedure, Nakano's circuit is not "complex" (column 1, line 46-48).

Arnon and Nakano disclose a feedback control circuit which uses a reference voltage/or predetermined threshold to control the gain of the APD. Harres provides a reliable detection and decoding method even at low power levels. Therefore, it would

have been obvious to one of ordinary skill in the art at the time the invention was made to apply the ratio of the energy states and a predetermined threshold as taught by Harres and Nakano to the system of Arnon et al so that the gain of the APD can be better controlled and the signal quality and reliability can be improved.

Regarding to the receiver in an environment exhibiting significant variation in temperature, the combination of Arnon et al and Harres and Nakano discloses a receiver with feedback and automatic gain control and wide dynamic range, and the gain control prevents the saturation of the APD. Anther prior art, Pulice, discloses that the APD with the automatic gain control allows for a wide range of light levels and can operate under extreme temperature (Abstract, column 1 line 45-50, column 3 line 19-26). Since combination of Arnon et al and Harres and Nakano discloses a APD with feedback and automatic gain control and wide dynamic range, it would have been obvious to one of ordinary skill in the art that the receiver of the combined Arnon et al and Harres and Nakano can also be used in an environment exhibiting significant variation in temperature.

2). With regard to claim 33, Arnon et al and Harres and Nakano and Pulice disclose all of the subject matter as applied to claim 32 above. And Arnon et al further discloses the method further including transmitting (e.g., Figure 4, the emitter 52) the optical signal to the receiver (Figure 4).

3). With regard to claim 35, Arnon et al and Harres and Nakano and Pulice disclose all of the subject matter as applied to claim 32 above. And Arnon et al and Harres and Nakano and Pulice further disclose wherein at least one of an amplification

of the transmitter (Figures 2-5 and 12 etc, [0237]-[0239], [0241] and [0268] etc., the feedback signal is sent to the transmitter to adjust the power level of the transmitter) and a gain of the receiver is adjusted to maintain a desired RMS level of a electrical signal (Harres: column 10, line 11-28).

4). With regard to claim 37, Arnon et al and Harres and Nakano and Pulice disclose all of the subject matter as applied to claim 32 above. And the combination of Arnon et al and Harres and Nakano and Pulice further discloses wherein an avalanche photodiode (e.g., Arnon: Figure 3, APD 158) is used to convert the optical signal, and wherein the ratio is compared with a breakdown threshold of the avalanche photodiode (refer to claim 32 rejection above. Arnon teaches to calculate the noise level and use the calculation to control the gain of the APD, a reference value or threshold must have been used in Arnon's system to make a decision to adjust the gain, and Nakano discloses a feedback control circuit (Figures 1 and 2), which uses a reference voltage/threshold for comparing and then to control the gain of the APD. And Harries teaches to reduce a gain of the receiver when the ratio of the signal power to the noise power is greater than a predetermined level, the level indicating that breakdown of the photodiode is imminent. That is, Harries teaches to reduce at least one of an optical amplification of the transmitter and a gain of the receiver when the ratio is greater than a predetermined threshold, the threshold indicating that breakdown of the photodiode is imminent. Pulice also teaches a breakdown threshold of the avalanche photodiode (Figure 2), and "the stabilization biasing circuit for avalanche photodiodes in accordance with the subject invention continuously adjusts the avalanche photodiode voltage to a

value just below the avalanche breakdown point. In this manner, the subject stabilization biasing circuit for an avalanche photodiode allows the high optical sensitivity of the avalanche photodiode to be realized over an extreme temperature range of at least -55^{o} C to +125^{o} C". That is, the combination of Arnon et al and Harres and Nakano and Pulice further teaches wherein the ratio is compared with a breakdown threshold of the avalanche photodiode).

5). With regard to claim 39, Arnon et al and Harres and Nakano and Pulice disclose all of the subject matter as applied to claim 32 above. And Arnon et al and Harres and Nakano and Pulice further disclose wherein computing the noise in the electrical signal includes integrating an energy value over a bit interval (Harres: column 7, line 3-23, and Figure 3).

6). With regard to claim 42, Arnon et al and Harres and Nakano and Pulice disclose all of the subject matter as applied to claim 32 above. And the combination of Arnon et al and Harres and Nakano and Pulice further discloses wherein the monitoring component is configured to reduce at least one of an amplification of the transmitter (Arnon: Figures 2-5 and 12 etc, [0237]-[0239], [0241] and [0268] etc., the feedback signal is sent to the transmitter to adjust the power level of the transmitter) and a gain of the receiver when a ratio of an average energy of a high-state A of the electrical signal and an average energy of a low-state A of the electrical signal is greater than a predetermined threshold (Arnon: page 10-11, [0237]-[0239], the gain of the APD is set according to the optical power level, the background noise level, and the aggregate noise. And as discussed for claim 32 and 37 above, Harres discloses a high energy

calculation component configured to compute average energies for the high-state and low state, and the signal-to-noise ratio can be used for calculating weight factor, and to reduce a gain of the receiver when the ratio of the signal power to the noise power is greater than a predetermined level indicating that breakdown of the photodiode is imminent. That is, the combination of Arnon et al and Harres and Nakano and Pulice further discloses to reduce a gain of the receiver when a ratio of an average energy of a high-state A of the electrical signal and an average energy of a low-state A of the electrical signal is greater than a predetermined threshold).

7). With regard to claim 43, Arnon et al and Harres and Nakano and Pulice disclose all of the subject matter as applied to claim 32 above. And the combination of Arnon et al and Harres and Nakano and Pulice further disclose the method comprising determining at least one of a presence or an absence of light at the receiver prior to computing the average noise energies (Harres: Figure 3, column 3 line 2-33, and Figure 3, "light" and "dark", or high state and low state, is determined prior to computing the average noise energies, refer step 34/36 and 38/40 in Figure 3).

7. Claims 5, 8-10, 12, 40, 44 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Arnon et al (US 2002/0114038) in view of Harres (US 6,128,112) and Pulice (US 5,270,533).

1). With regard to claim 44, Arnon et al discloses an apparatus (Figure 3) operable in an environment exhibiting significant variation in temperature, comprising:

an optical signal transmitter (e.g., Figure 4, the emitter 52); and

an optical signal receiver (Avalanche Photodiode 150 in the opto-electric transducer 162 receives optical signal, Figure 3) for receiving an optical signal from the transmitter, the receiver including a photodiode (Avalanche Photodiode 150 in Figure 3) for converting the optical signal to an electrical signal;

the receiver further including a feedback loop (e.g., Figure 3, the feedback loop 154 ->156 ->158 and then to 150) for monitoring the electrical signal outputted by the photodiode, computing noise energies in the monitored signal (the monitoring signal is part of the electrical signal split from the output of amplifier 152, Figure 3; the gain of the APD is set according to the optical power level, the background noise level, and the aggregate noise, [0036] and [0237]-[0239]), and adjusting gain of the photodiode as a function of the monitored noise energies (page 10-11, [0237]-[0239], the gain of the APD is set according to the optical power level, the background noise level, and the aggregate noise);

wherein the feedback loop adjusts the gain without using measured temperature of the environment (in Arnon's system, no temperature controlling/monitoring devices are used).

But, Arnon et al does not expressly state to computing a ratio of noise energy for high and low signal in the monitored signal, and adjusting gain of the photodiode as a function of the ratio; and the apparatus is “operable” in an environment exhibiting significant variation in temperature.

With regard to the ratio of noise energy for high and low signal in the monitored signal, however, Harres, in the same field of endeavor, discloses an optical receiver

with a monitoring component: monitoring a noise level including determining a presence or absence of the optical signal at the receiver (column 3 line 2-33, and Figure 3, "light" and "dark", or high state and low state, is determined), computing at least one of a high state means and a low state means of the electrical signal (Figure 3, the powers of the signals at high and low states are calculated), computing an average noise energy for the high-state A, computing an average noise energy for the low-state –A (38 and 40 in Figure 3, column 10 line 11-40), and computing a ratio of the average noise energies for the high- and Low state A, -A (42 in Figure 3, column 10 line 11-40). Harries also teaches "[a]s supported by equation 7, however, as m>>1, the improvement in S/N asymptotically approaches the expression $1/2(m+2)^{1/2}$. Of coursea natural limit exists on the APD gain (M) beyond which breakdown occurs. In addition, as M becomes very large, the multiplied bulk dark current (the second term in the denominator of equation 2) will begin to dominate. Thus, by increasing the gain M beyond the point at which the multiplied bulk dark current begins to dominate the noise statistics, the SNR will again begin to degrade. Further, since the multiplied bulk dark current exists at all times, i.e., since the bulk dark current is not signal dependent, there currently is no known way to remove its effect using non-linear processing methods. Thus, the gain of the photodetector is preferably maintained at <u>levels below which the bulk dark current dominates</u>.". That is, Harries teaches to adjust gain of the receiver/photodiode as a function of the ratio.

Harres teaches that ratio of the average noise energies is used for calculating a weight factor, and to reduce a gain of the receiver when the ratio of the signal power to

the noise power is greater than a predetermined level. Harres provide a more reliable method and apparatus for detecting and decoding digital signals; and "[i]t is a further object of the invention to provide a method and apparatus for reliably detecting low level signals by increasing the gain of the detector without unduly increasing the bit error rate".

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the ratio of the average noise energy states as taught by Harres to the system of Arnon et al so that the gain is adjusted when a ratio of the average noise energies for the high- and low-states is greater than a predetermined threshold, and then the gain of the APD can be better controlled and the signal quality and reliability can be improved.

With regard to the environment exhibiting significant variation in temperature, Arnon et al and Harries disclose that the receiver has feedback and automatic gain control and wide dynamic range, and the gain control prevents the saturation of the APD. Another prior art, Pulice, discloses that the APD with the automatic gain control allows for a wide range of light levels and can operate under extreme temperature (Abstract, column 1 line 45-50, column 3 line 19-26). Since Arnon et al and Harres discloses a receiver with feedback and automatic gain control and wide dynamic range, it would have been obvious to one of ordinary skill in the art at the time the invention was made that the receiver of Arnon et al and Harres can also be "operable" in an environment exhibiting significant variation in temperature.

2). With regard to claim 5, Arnon et al and Harres and Pulice disclose all of the subject matter as applied to claim 44 above. And the combination of Arnon et al and Harres and Pulice further discloses wherein the feedback loop adjusts at least one of an amplification of the transmitter (Arnon: Figures 2-5 and 12 etc, [0237]-[0239], [0241] and [0268] etc., the feedback signal is sent to the transmitter to adjust the power level of the transmitter) and a gain of the photodiode to maintain a desired RMS level of the electrical signal (Harres: column 10, line 11-28).

3). With regard to claim 8, Arnon et al and Harres and Pulice disclose all of the subject matter as applied to claim 44 above. And the combination of Arnon et al and Harres and Pulice further discloses e wherein the receiver includes an integrate-and-dump circuit that integrates an energy value of the noise over a bit interval (Harres: column 7 line 3 to column 8 line 65, and Figure 3).

4). With regard to claim 9, Arnon et al and Harres and Pulice disclose all of the subject matter as applied to claims 44 and 8 above. And Arnon et al and Harres and Pulice further disclose wherein the receiver includes a subtractor component (Harres: column 10 line 15-20) that receives a state indicator signal (Harres: column 3 line 2-33) and subtracts a high-state +A or a low-state -A state from the electrical signal based on the state indicator signal (Harres: the state indicator determines the states or phase of the optical signal: light (or high) and dark (or low) portions; and power determining means for determining the power of the respective noise portions of the two phase segments, Figure 3, step 38/40, subtract nominal signal power).

5). With regard to claim 10, Arnon et al and Harres and Pulice disclose all of the subject matter as applied to claims 44, 8 and 9 above. And Arnon et al and Harres and Pulice further disclose wherein the noise energy calculation component includes a squaring function that squares an output from the subtractor component and transmits the squared output to the integrate-and-dump circuit (Harres: column 7, line 3-31, and column 10 lines 11-62).

6). With regard to claim 12, Arnon et al and Harres and Pulice disclose all of the subject matter as applied to claim 44 above. And the combination of Arnon et al and Harres and Pulice further discloses wherein the feedback loop includes a state means calculation component configured to compute at least one of a high state means and a low state means of the electrical signal (Harres: column 3 line 2-33, and Figure 3, power determining means for determining the power of the respective noise portions of the two phase segments).

7). With regard to claim 40, Arnon et al and Harres and Pulice disclose all of the subject matter as applied to claim 44 above. And the combination of Arnon et al and Harres and Pulice further discloses wherein computing noise in the electrical signal includes receiving a state indicator signal that indicates a condition of the optical signal, and subtracting a high-state +A or a low-state -A state from the electrical signal based on the state indicator signal (Harres: column 3 line 2-33, column 10 line 15-20) that indicates a condition of the optical signal (the state indicator determines the states or phase of the optical signal: light (or high) and dark (or low) portions), and subtracting a

high-state +A or a low-state -A state from the electrical signal based on the state indicator signal (step 38/40 in Figure 3, subtract nominal signal power).

8). With regard to claim 45, Arnon et al and Harres and Pulice disclose all of the subject matter as applied to claim 44 above. And, the combination of Arnon et al and Harres and Pulice further discloses wherein the photodiode is an avalanche photodiode (Avalanche Photodiode 150 in Figure 3); and wherein the feedback loop computes a ratio of high- and low-states to prevent breakdown of the photodiode and possible interruption of the receiver (Arnon: [0016], [0110], [0237]-[0239], [0250], [0291] , the optical power level, the background noise level, the aggregate noise, and the signal to noise ratio are calculated, the gain is controlled so to prevent saturation of the APD. As discussed in claim 44 rejection, the combination of combination of Arnon et al and Harres and Pulice teaches/suggests the feedback loop computes a ratio of high- and low-states to prevent breakdown of the photodiode and possible interruption of the receiver).

8. Claims 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Arnon et al and Harres and Pulice as applied to claims 44 and 45 above, and in further view of Nakano (US 6,795,675).

1). With regard to claim 13, Arnon et al and Pulice disclose all of the subject matter as applied to claims 44 and 45 above. And the combination of Arnon et al and Harres and Pulice further discloses wherein the feedback loop includes: a high energy calculation component configured to compute an average energy for the high-state A; a low energy calculation component configured to compute an average energy for the

low-state -A; and a comparator configured to compare a ratio of the average energies for the high- and low-states A, -A with a predetermined level, the predetermined level indicating that breakdown of the photodiode is imminent (Harres: column 3 line 2-33, Figure 3, the powers of the signals at high and low states are calculated; and Harries also teaches "[a]s supported by equation 7, however, as m>>1, the improvement in S/N asymptotically approaches the expression $1/2(m+2)^{1/2}$. Of coursea natural limit exists on the APD gain (M) beyond which <u>breakdown</u> occurs. In addition, as M becomes very large, the multiplied bulk dark current (the second term in the denominator of equation 2) will begin to dominate. Thus, by increasing the gain M beyond the point at which the multiplied bulk dark current begins to dominate the noise statistics, the SNR will again begin to degrade. Further, since the multiplied bulk dark current exists at all times, i.e., since the bulk dark current is not signal dependent, there currently is no known way to remove its effect using non-linear processing methods. Thus, the gain of the photodetector is preferably maintained at <u>levels below which the bulk dark current dominates</u>", column 9, line 33-49, that is, Harres discloses a comparator configured to compare a ratio of the average energies for the high- and low-states A, -A with a predetermined level, the predetermined level indicating that breakdown of the photodiode is imminent).

Regarding to the predetermined threshold, since Arnon teaches to calculate the noise level and use the calculation to control the gain of the APD, it is obvious that a reference value or threshold is used in Arnon's system to make a decision to adjust the gain. For control purpose, a criterion must be used to judge the level of the signal/noise

so to control the operation of the device being controlled. And another prior art, Nakano, discloses a feedback control circuit (Figures 1 and 2), which uses a reference voltage/or predetermined threshold to control the gain of the APD.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to a predetermined threshold as taught by Nakano to the system of Arnon et al and Harres and Pulice so that the gain of the APD can be better controlled and the signal quality and reliability can be improved.

2). With regard to claim 14, Arnon et al and Harres and Pulice disclose all of the subject matter as applied to claims 44 and 45 above. And the combination of Arnon et al and Harres and Pulice disclose wherein the ratio is a ratio of an average energy of a high-state A of the electrical signal and an average energy of a low-state A of the electrical signal is greater than predetermined level, the predetermined level indicating that breakdown of the photodiode is imminent (Harres: column 3 line 2-33, Figure 3, the powers of the signals at high and low states are calculated; and Harries also teaches "[a]s supported by equation 7, however, as m>>1, the improvement in S/N asymptotically approaches the expression $1/2(m+2)^{1/2}$. Of coursea natural limit exists on the APD gain (M) beyond which <u>breakdown</u> occurs. In addition, as M becomes very large, the multiplied bulk dark current (the second term in the denominator of equation 2) will begin to dominate. Thus, by increasing the gain M beyond the point at which the multiplied bulk dark current begins to dominate the noise statistics, the SNR will again begin to degrade. Further, since the multiplied bulk dark current exists at all times, i.e., since the bulk dark current is not signal dependent, there currently is no known way to

remove its effect using non-linear processing methods. Thus, the gain of the photodetector is preferably maintained at <u>levels below which the bulk dark current dominates</u>", column 9, line 33-49, that is, Harres discloses the ratio is an ratio of an average energy for the high-state of the electrical and an average energy of a low-state A of the electrical signal is greater than predetermined level, the predetermined level indicating that breakdown of the photodiode is imminent).

Regarding to the predetermined threshold, since Arnon teaches to calculate the noise level and use the calculation to control the gain of the APD, it is obvious that a reference value or threshold is used in Arnon's system to make a decision to adjust the gain. For control purpose, a criterion must be used to judge the level of the signal/noise so to control the operation of the device being controlled. And another prior art, Nakano, discloses a feedback control circuit (Figures 1 and 2), which uses a reference voltage/or predetermined threshold to control the gain of the APD.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to a predetermined threshold as taught by Nakano to the system of Arnon et al and Harres and Pulice so that the gain of the APD can be better controlled and the signal quality and reliability can be improved.

Allowable Subject Matter

9. Claims 24, 26-29 and 31 are allowed.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to LI LIU whose telephone number is (571)270-1084. The examiner can normally be reached on Monday-Friday, 8:30 am - 6:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ken Vanderpuye can be reached on (571)272-3078. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/Li Liu/
Examiner, Art Unit 2613
January 12, 2010